Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (previously presented): A method of positioning a movable body suspended in a magnetic bearing system comprising a single displacement sensor, the sensor being an axial displacement sensor, wherein the method comprises the steps of:

measuring the axial position of the movable body with the sensor to produce an axial displacement output;

storing a plurality of axial displacement outputs over a period of time;

adjusting the axial displacement output to account for a sensor offset estimated using stored axial displacement outputs to produce an adjusted axial displacement output;

converting the adjusted axial displacement output to a force for positioning the movable body; and

positioning the movable body with said force.

Claim 2 (previously presented): The method of claim 1, wherein converting the adjusted axial displacement output to a force comprises inputting the adjusted axial displacement output into a position controller configured to determine the point of substantial axial equilibrium of the movable body.

Claim 3 (previously presented): The method of claim 2, wherein converting the adjusted axial displacement output to a force for positioning the movable body comprises creating a mechanical force to position the movable body at the point of substantial axial equilibrium.

Claim 4 (previously presented): The method of claim 2, wherein converting the adjusted axial displacement output to a force for positioning the movable body comprises creating an electromagnetic force to position the movable body at the point of substantial axial equilibrium.

Claim 5 (canceled)

Claim 6 (canceled)

Claim 7 (previously presented): The method of claim 1, wherein the period of time is determined by comparing a variance of the plurality of axial displacement outputs against a predetermined threshold to determine a start time and an end time.

Claim 8 (previously presented): The method of claim 1, wherein a selective plurality of axial displacement outputs are used to estimate the sensor offset, the axial displacement offsets being selected by comparing a magnitude of the axial displacement offset against a predetermined threshold.

Claim 9 (previously presented): The method of claim 1, wherein estimating the sensor offset further comprises taking an average value of the stored axial displacement outputs.

Claim 10 (previously presented): The method of claim 1, wherein estimating the sensor offset further comprises taking a weighted average value of the stored axial displacement outputs.

Claim 11 (previously presented): The method of claim 1, wherein estimating the sensor offset further comprises determining a median value of the stored axial displacement outputs.

Claim 12 (previously presented): The method of claim 1, wherein estimating the sensor offset further comprises determining the mode value of the stored axial displacement outputs.

Claim 13 (previously presented): The method of claim 1, wherein the magnetic bearing system further comprises memory for storing axial displacement outputs.

Claim 14 (original): The method of claim 13, further comprising storing the estimated sensor offset in memory.

Claim 15 (previously presented): The method of claim 13, further comprising storing adjusted axial displacement outputs in memory.

Claim 16 (original): The method of claim 14, further comprising recalling the estimated sensor offset and utilizing the estimated sensor offset to position the movable body to a point of substantial axial equilibrium.

Claim 17 (previously presented): The method of claim 15, further comprising recalling the adjusted axial displacement output and utilizing the adjusted axial displacement output to position the movable body to a point of substantial axial equilibrium.

Claim 18 (original): The method of claim 1, wherein measuring comprises measuring the axial position of the movable body when it is levitating.

Claim 19 (previously presented): A method of positioning a movable body suspended in a magnetic bearing system comprising a single displacement sensor, the sensor being an axial displacement sensor, wherein the method comprises the steps of:

measuring the displacement of the movable body with the sensor to produce a displacement output;

storing a plurality of axial displacement outputs over a period of time;

estimating a sensor offset using the stored displacement outputs;

adjusting the displacement output by the estimated sensor offset to create an adjusted displacement output;

inputting the adjusted displacement output into a body position controller configured to determine the point of substantial axial equilibrium of the movable body;

converting the adjusted displacement output to an electromagnetic force for positioning the movable body;

positioning the movable body to a point of substantial axial equilibrium; and

repeating the previous steps.

Claim 20 (original): The method of claim 19, wherein estimating the sensor offset further comprises storing a plurality of displacement outputs over a period of time, the plurality of displacement outputs being derived from axial position measurements of the movable body.

Claim 21 (original): The method of claim 20, wherein the period of time is determined by comparing a variance of the plurality of displacement output against a predetermined threshold to determine a start time and an end time.

Claim 22 (original): The method of claim 20, wherein a selective plurality of displacement outputs are used to estimate the sensor offset, the displacement offsets being selected by comparing a magnitude of the displacement offset against a predetermined threshold.

Claim 23 (original): The method of claim 20, wherein estimating the sensor offset further comprises taking an average value of the stored displacement outputs.

Claim 24 (previously presented): The method of claim 20, wherein estimating the sensor offset further comprises taking a weighted average value of the stored displacement outputs.

Claim 25 (original): The method of claim 20, wherein estimating the sensor offset further comprises determining a median value of the stored displacement outputs.

Claim 26 (original): The method of claim 20, wherein estimating the sensor offset further comprises determining the mode value of the stored displacement outputs.

Claim 27 (original): The method of claim 19, wherein the magnetic bearing system further comprises memory for storing data.

Claim 28 (original): The method of claim 27, further comprising storing the estimated sensor offset in memory.

Claim 29 (original): The method of claim 28, further comprising recalling the estimated sensor offset and utilizing said offset to position the movable body to a point of substantial axial equilibrium during a reset of the system.

Claim 30 (original): The method of claim 20, further comprising storing the adjusted displacement outputs in memory.

Claim 31 (original): The method of claim 30, further comprising recalling the adjusted displacement output and utilizing the adjusted displacement output to position the movable body to a point of substantial axial equilibrium.

Claim 32 (original): The method of claim 19, wherein measuring comprises measuring the movable body when it is levitating.

Claim 33 (currently amended): A system for positioning a movable body suspended in a magnetic bearing apparatus, the system comprising:

a single displacement sensor for measuring the displacement of the movable body and providing a displacement output, the sensor being an axial displacement sensor;

a sensor offset compensation module, configured to receive said displacement output from the sensor, record <u>and store a plurality of</u> received displacement outputs <u>over a period of time</u>, and adjust said displacement output to account for a sensor offset estimated from said received displacement outputs, producing an adjusted displacement output;

a position control module configured to receive and use the adjusted displacement output of the sensor offset compensation module to approximate the point of substantial axial equilibrium of the movable body; and

an actuator module for converting an output of the position control module into a force for positioning the movable body to the point of substantial axial equilibrium.

Claim 34 (original): The system of claim 33, wherein the sensor is configured to convert the displacement output to a displacement voltage.

Claim 35 (original): The system of claim 33, wherein the sensor offset compensation module is configured to provide an estimated sensor offset and adjust the displacement output by the estimated sensor offset to create an adjusted displacement output.

Claim 36 (canceled)

Claim 37 (currently amended): The system of claim [[36]] <u>33</u>, wherein the sensor offset compensation module compares a variance of the plurality of displacement outputs against a predetermined threshold to determine a start time and an end time.

Claim 38 (currently amended): The system of claim [[36]] 33, wherein a selective plurality of displacement outputs are used to estimate the sensor offset, the displacement offsets being selected by comparing a magnitude of the displacement offset against a predetermined threshold.

Claim 39 (currently amended): The system of claim [[36]] 33, wherein the sensor offset compensation module estimates the sensor offset by taking an average value of the stored displacement outputs.

Claim 40 (currently amended): The system of claim [[36]] 33, wherein the sensor offset compensation module estimates the sensor offset by taking a weighted average value of the stored displacement outputs.

Claim 41 (currently amended): The system of claim [[36]] 33, wherein the sensor offset compensation module estimates the sensor offset by determining a median value of the stored displacement outputs.

Claim 42 (currently amended): The system of claim [[36]] 33, wherein the sensor offset compensation module estimates the sensor offset by determining the mode value of the stored displacement outputs.

Claim 43 (original): The system of claim 33, wherein the actuator module is configured to convert the output from the position control module to create a mechanical force to position the movable body to the point of substantial axial equilibrium.

Claim 44 (original): The system of claim 33, wherein the actuator module is configured to convert the output from the position control module to create an electromagnetic force to position the movable body to the point of substantial axial equilibrium.

Claim 45 (original): The system of method of claim 33, wherein the magnetic bearing system further comprises memory for storing data.

Claim 46 (original): The system of claim 45, wherein the memory stores an estimated sensor offset in memory.

Claim 47 (original): The system of claim 46, wherein the position control module uses the estimated sensor offset stored in memory to position the movable body to a point of substantial axial equilibrium during a reset of the system.

Claim 48 (original): The system of claim 45, wherein the memory stores an adjusted displacement output in memory.

Claim 49 (original): The system of claim 46, wherein the position control module uses the adjusted displacement output stored in memory to position the movable body to a point of substantial axial equilibrium during a reset of the system.

Claim 50 (previously presented): A method of positioning a magnetically suspended rotor in a pump apparatus, the pump apparatus comprising at least one permanent magnet, at least one electro magnet, a single rotor position sensor, the sensor being an axial displacement sensor, and a rotor position controller, comprising:

measuring the displacement of the rotor in the axial direction with the sensor to produce a displacement output;

converting the displacement output into a displacement voltage;

storing a plurality of displacement outputs over a period of time;

estimating a sensor offset using the displacement outputs;

adjusting the displacement output by the estimated sensor offset to create an adjusted displacement output;

inputting the adjusted displacement output into the rotor position controller configured to determine the point of substantial axial equilibrium of the rotor;

converting the output of the rotor position controller into an electromagnetic force;

positioning the rotor to a point of substantial axial equilibrium by adjusting the voltage to the electromagnet; and

repeating the previous steps.

Claim 51 (original): The method of claim 50, further comprising storing the estimated sensor offset in memory.

Claim 52 (original): The method of claim 51, further comprising recalling the estimated sensor offset and utilizing said offset to position the movable body to a point of substantial axial equilibrium during a reset of the system.

Claim 53 (original): The method of claim 50, further comprising storing the adjusted displacement output in memory.

Claim 54 (original): The method of claim 53, further comprising recalling the adjusted displacement output and utilizing said offset to position the movable body to a point of substantial axial equilibrium during a reset of the system.

Claim 55 (original): The method of claim 50, wherein estimating the sensor offset further comprises averaging a plurality of stored displacement outputs, said plurality of displacement outputs being derived by measuring the displacement of the positioned rotor over a period of time.

Claim 56 (original): The method of claim 55, wherein the sensor offset compensation module compares a variance of the plurality of displacement outputs against a predetermined threshold to determine a start time and an end time.

Claim 57 (original): The method of claim 56, wherein the sensor offset compensation module estimates the sensor offset by taking an average value of the displacement outputs stored between the start time and the end time.

Claim 58 (original): The method of claim 50, wherein a selective plurality of displacement outputs are used to estimate the sensor offset, the displacement offsets being selected by comparing a magnitude of the displacement offset against a predetermined threshold.

Claim 59 (original): The method of claim 58, wherein estimating the sensor offset further comprises taking an average value of the stored displacement outputs.

Claim 60 (previously presented): The method of claim 50, wherein measuring comprises measuring the axial position of the movable body when it is levitating.

Claim 61 (previously presented): A magnetically suspended pump apparatus, comprising:

a housing comprising an inlet port and an outlet port for receiving and discharging fluid respectively;

a rotor positioned within the housing for pumping blood between the housing's inlet port and outlet port;

a plurality of permanent magnets for passively controlling the radial position of the rotor radially, and the pitch and yaw of the rotor;

an electromagnet for actively controlling the position of the rotor in the axial direction;

an electromagnetic motor for rotating the rotor about a central axis;

a sensor for measuring the axial displacement of the rotor;

a computer comprising memory for storing and recalling sensor data;

an offset compensation module for adjusting an output of the sensor to account for sensor offset;

a rotor position controller for positioning the rotor at the point of substantial axial equilibrium; and

an actuator for creating an electromagnetic force to position the rotor.

Claim 62 (canceled)

Claim 63 (previously presented): The pump apparatus of claim 61, wherein the computer controls the operation of the pump apparatus.

Claim 64 (previously presented): The pump apparatus of claim 61, wherein the computer in configured to recall saved sensor data upon reboot or reset of the computer.

Claim 65 (original): The pump apparatus of claim 61, wherein the position controller is configured to balance the passively controlled forces acting on the rotor.

Claim 66 (original): The pump apparatus of claim 61, wherein the rotor position controller is a virtual zero power controller.

Claim 67 (previously presented): A method of positioning a magnetically suspended rotor in a pump apparatus, the pump apparatus comprising at least one permanent magnet, at least one electro magnet, a single axial rotor position sensor, and a rotor position controller, comprising:

measuring and storing the displacement of the rotor in a plurality of positions to produce a plurality of displacement outputs;

estimating a sensor offset using the displacement outputs;

adjusting the displacement output by the estimated sensor offset to create an adjusted displacement output;

inputting the adjusted displacement output into the rotor position controller configured to determine the point of substantial axial equilibrium of the rotor; and

converting the output of the rotor position controller into a force for positioning the rotor.